THE
General Doctrine
OF
Equation

Reduced into brief Precepts.

In III. Chapters.

Derived from the Works of the beſt
Modern Analyſts.

By MICHAEL DARY, *Philomath.*

LONDON:
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Courteous Reader,

A*Bout a Year and an half ſince there came to my peruſal the incomparable Treatiſe of* Florimondo de Beaun, *of the nature and limits of* Equations; *the contemplation whereof cauſed me* (rudi Minerva) *to draw up* The Doctrine of Equation *for my own uſe; and perceiving that the later part of the aforeſaid Treatiſe about the Limits of Equations might be ſpared, and ſupplied by the poſſibility of the firſt Figure of the Root, I communicated my Obſervations of this nature to others, who deſirous thereof have inclined me to publiſh the ſame to ſave the trouble of Tranſcription. Now if my dim Taper may adminiſter any light to others, I have obtained my ambition, which is to be accounted*

A Lover and Servitor
to Art and Artiſts,

London,
Jan. 1. 1664.

MICHAEL DARY.

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The Doctrine of EQUATION comprised in three Chapters.

CHAP. I.

Of Equation, and the true ſtating and purging of a Mathematical queſtion, whereby (if need be) to bring it into one Equation.

1. E*Quation* is when one Quantity is equal to one Quantity, or when one Quantity is equal to many Quantities, or when many Quantities are equal to many Quantities.

2. Any Equation may be *reduced* to a new Homogeneal Equation, if each ſide be augmented or diminiſhed equally by Addition, Subſtraction, Multiplication, Diviſion, Involution or Devolution.

3. Any Mathematical Queſtion may be propoſed in an Equation, or in ſeveral Equations, coherent in reſpect of the unknown quantities.

4. Therefore when a Queſtion of this nature is propoſed, and Reſolution deſired, let there be put (Symbolically) for every quantity therein mentioned ſome Letter of the Alphabet, (for the known quantities thoſe Letters towards the beginning of the Alphabet ; and for the unknown, thoſe Letters towards the later end of the Alphabet :) then ſhall

you ſtate the whole buſineſs of the Queſtion *by Ratiocination therein requiſite*, (for which purpoſe you ought to be ſufficiently furniſhed with Analytical ſtore) into an Equation, or into ſeveral coherent Equations: which coherent Equations ought to be one to another irreducible or heterogeneal.

5. If (in a queſtion ſo ſtated) the unknown Symbols be more then the Equations, that queſtion is *impertinent*, and capable of an infinite number of Anſwers: But if the unknown Symbols be not more then the Equations, that queſtion is *pertinent*, and not capable of an infinite number of Anſwers.

6. If the queſtion propoſed be pertinent, and ſtated into ſeveral Equations, you ſhall (by the 2. hereof) *purge* thoſe Equations of all the unknown Symbols, excepting that which is deſired to be known; and ſo the queſtion will ſtand in one Equation.

CHAP.

CHAP. II.

Of clearing and trimming an Equation, whereby to know (what Roots and how many it hath, viz.) the Conſtitution thereof.

1. If there be any Fractions in the Equation, let them be cleared of their Nominators by Ch. 1. Sect. 2. Alſo by the ſame let the Surd Roots be taken away if there be any.

2. If the unknown Symbol be found in all the Terms, you ſhall clear as many of the Terms of it as may be cleared by Chap. 1. Sect. 2. But if all the Terms may be cleared, that Equation is *identical*.

3. If there be a *Cofactor* in the firſt Term, let it be cleared away, (if it may be done without Fractionizing any other Term) by Chap. 1. Sect. 2.

4. Let all thoſe Terms on the right ſide of the Equation be tranſpoſed to the left by Chap. 1. Sect. 2.

5. Let all Homogeneal Terms be gathered into one Term by the preſcription of their Signs and Cofactors: placing the higheſt Poteſtate of the unknown Symbol firſt, (moſt ſiniſterly) and the reſt of the inferiour Poteſtates ſucceeding in their order, the *abſolute* being laſt; and on the right ſide of the Equation put a Cypher.

6. If the Abſolute be affirmed, you ſhall make it denied by changing all the Signs throughout the

Equa-

Equation ; ſo is the Equation *cleared.*

7. This done, you ſhall expugne all the known Symbols ; and put their reſpective Numbers in their rooms ; and now you may call it *a trimm'd Equation.*

8. Every trimm'd Equation hath ſo many Roots as is intimated by the Index of the unknown Symbol in the firſt Term; whereof there are ſo many true Roots, as the Signs (in their order) have Changes, and the reſt are falſe Roots.

9. An [true / falſe] Root of a trimm'd Equation is a number or quantity [greater / leſſer] then nothing, which wrought according to the Conſcription of the unknown Symbol, the reſult is [always / ſometimes] equal to nothing.

10. In a trimm'd Equation having all the Poteſtates of the unknown Symbol extant, if you change the Signs in even places, the true Roots are turned to falſe Roots, and the falſe Roots to true.

11. In a trimm'd Equation, having all the Poteſtates of the unknown Symbol extant, if you change the Signs in even places,

The Cofactor in the ſecond Term is equal to the ſumme of all the ſingle Roots.

The Cofactor in the third Term is equal to the ſumme of the Facts of every two Roots.

The Cofactor in the fourth Term is equal to the ſumme of the Facts of every three Roots, &c.

Multiplied by the Cofactor in the firſt Term.

12. In every trimm'd Equation the unknown Symbol is *arbitrarily* equal to any one of the Roots (whether true or falſe) as conſtituting the Equation propoſed.

13. If therefore to the unknown Symbol a true Root be connexed with the Sign — or a falſe Root with the Sign + ; every ſuch Connexion may not unfitly be called *an equated Binomial*.

14. Every trimm'd Equation is *conſtituted* by the Fact of all its equated Binomials multiplied by the Cofactor in the firſt Term.

15. All trimm'd Equations, wherein the Signs are not changed, are *always* impoſſible: yea and *ſometimes* (alſo) although the Signs are changed, as in ſome pretended trimm'd Equations.

CHAP. III.

Of the conſtruction and uſe of the Canon, whereby th poſſibility or impoſſibility of any trinom'd Equation is diſcovered, as alſo one of the true Roots educed in number, and conſequently all the reſt of the true Roots.

1. LEt the Abſolute Number be tranſpoſed to the right ſide of the Equation, and then you may call it *the Reſolvend.*

2. Now if you ſubſtitute in the room of the unknown Symbol, any Binomial ; as (if you pleaſe) $l+n$: then are all the Poteſtates of $l+n$ equal to all the like Poteſtates of the unknown Symbol, which Poteſtates of $l+n$ being orderly placed do make up the *Canon* for the Equation propoſed.

3. Let the Reſolvend be placed on the right ſide of the Canon, with the Sign of Equation between them, and draw a curved line on the right ſide of the Reſolvend for a Quotient or Receptacle for the *queſitious root.*

4. Beginning at the place of Units, let the Reſolvend be pointed into Periods, as is intimated by the ſeveral Poteſtates of the unknown Symbol, *viz.* for a Root every ſingle Figure, for a Square every ſecond Figure, for a Cube every third Figure, and ſo on ; extending toward the left hand for a whole Number, but towards the right hand for a Decimal Fraction ; completing the Reſol-

vend with Cyphers if need be, for there muſt be as many Periods for one Poteſtate as another, and no more; of which Periods ſo ſeated, one of every ſort of the ſame gradual diſtance from the place of Units, are called *a congruent ſet.*

5. Having thus limited the Reſolvend by Punctation, you ſhall put for the firſt Figure of the Root, (*viz.* for *l*) the greateſt Figure that may be; *always provided* that thoſe parcels in the Canon which have not the Secundary Root *n* in them, being collected according to the firſt, (if need be, ſecond or third, &c.) congruent ſet of Periods into one Reſult, may be ſubducted from the correſpondent part of the Reſolvend limited by Punctation; and the Remainer retaining the ſame Sign with the Reſolvend, muſt be always leſs then the *ſucceeding Diviſor.*

6. (Subduction being made, let all thoſe parcels in the Canon which have not the Secundary Root *n* in them be expugned, for they are no more to be uſed.)

7. Now and henceforward in the enquiry for every ſucceeding Figure of the Root, *l* ſhall repreſent (or be equal to) that part of the Root already found; and *n* ſhall repreſent that next ſucceeding Figure of the Root which is enquired for.

8. To the Remainer you ſhall regularly draw down ſo much of the Reſolvend as is limited by the laſt Period of the *next* congruent ſet of Periods, makes your *Minorand*, having the ſame Sign with the Reſolvend.

9. That

9. That there may be ſome light exhibited f the chuſing of the next ſucceeding Figure of th Root, the known part of the Canon (for therein nothing unknown but *n*) being collected acco ding to the *precedent* Congruent ſet of Periods in to one Reſult makes your *Diviſor*, having th ſame Sign with the Reſolvend; the laſt Remaine decuplicated being your *Dividend*.

10. (But if there cannot be ſuch a Diviſor mad as is required by the 5. hereof, that Equation is *impoſſible*; if there may, it is *poſſible*.)

11. By enquiry and ſome trial you ſhall pu for the next ſucceeding Figure of the Root, (*viz.* for *n*) the greateſt Figure that may be; *always provided* that *l* being decuplicated, the whole Canon (for now therein is nothing unknown) being collected according to the *preſent* congruent ſet of Periods into one Reſult, may make a *Subducend*, having the ſame Sign with the Reſolvend; which being ſubducted from the foreſaid Minorand, the Remainer retaining the ſame Sign, muſt be always leſs then the ſucceeding Diviſor.

12. And ſo you may proceed to find every Figure of the Root, repeating the 8, 9, and 11. hereof, leaving out the 10, for if the firſt Figure of the Root be poſſible, all the reſt are poſſible.

13. Now if it be required to find another of the unknown true Roots, (if there be any) let the Equation as it ſtood trimm'd by Chap. 2. Sect. 7. be di-

vided by the equated Binomial, *viz.* the unknown Symbol leſs the new-known Root: and the Quo-ient is a trimm'd Equation, (one degree lower then the Dividend) conſtituted (Ch. 2. Sect. 14.) by the Fact of all the remaining equated Binomials, multiplied by the Cofactor in the firſt Term.

Therefore you may proceed to find that other true Root required, (and conſequently all the reſt of the true Roots one after another, if need be) by repeating this whole Chapter, excepting the 10. hereof; for if one true root be poſsible, all the reſt are poſsible.

Laus Deo.

FINIS.

POST-SCRIPT.

The former Precepts are general, and (as the Author conceives) neither redundant nor deficient, and are explained in the Examples of other learned Analyſts, as in Mr. Oughtreds *Clavis, and Mr.* Moores *Specious Arithmetick joyned with his Conick Sections, books of excellent uſe, ſold by* Nath. Brook.